Enhanced Energy Transport Processes

A Collaborative Effort between the US Air Force Research Laboratory and National Laboratories

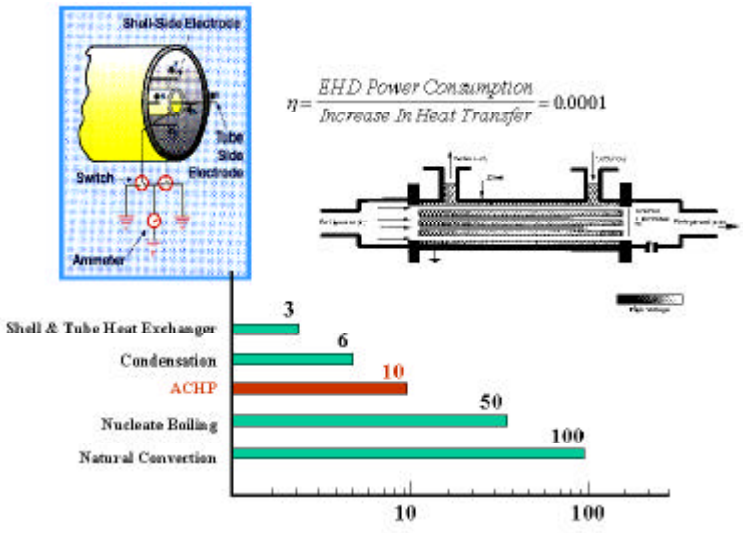
THE PROBLEM:

Enhanced energy transport processes (such as heat transfer and fluid dynamics) maximize the efficiency and minimize the size and weight of an energy system. For example, current Bare Base Environmental Control Units (ECUs) are based on 1960's technology, drafting 40 percent of all mobile electric power (MEP) and accounting for more than ten percent of the initial and follow-on deployment weight. Enhancing the heat transfer process to two-fold increases the efficiency by 20 percent and/or reduces the size and weight by 50 percent.

Energy Systems Used In Bare Bases

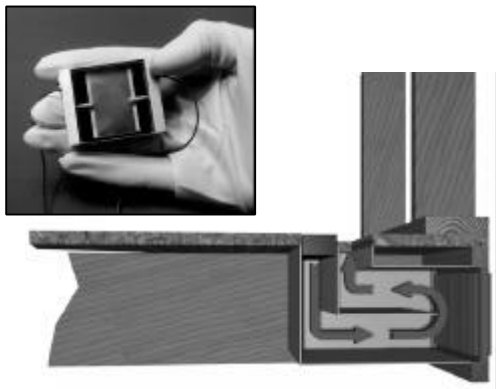
THE SOLUTION:

The Air Force Research Laboratory, Materials and Manufacturing Directorate, Airbase and Environmental Technology Division (AFRL/MLQ), is developing technologies to enhance heat transfer and fluid dynamics processes. One of these technologies is Electrohydrodynamic (EHD). EHD is the science and technology of flows and related transport processes caused by an externally imposed strong electric field. EHD dramatically enhances heat transfer with negligible energy input. Enhancement can be increased 100-fold.



EHD Enhancement for Different Applications

Microchannels is another technology being developed by AFRL/MLQ to enhance the performance of energy systems, in particular reforming diesel fuel for fuel cell applications. Microchannels heat flux can reach 200 kW/m^2, several orders of magnitude of conventional technologies. Applying microchannels to energy systems accomplishes two goals. It enhances heat flux and miniaturizes energy transport devices, thereby achieving greater savings in energy consumption and greater reduction in size and weight of an energy system.



Microchannels Heat Exchangers

AFRL/MLQ is embarking on combining these two technologies to further enhance the performance of energy systems. Expected benefits include lower voltage to achieve strong electric field, lower pressure drop in microchannels, higher heat flux, and improved airside performance.

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